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Precise regional groundwater table measurements at the Yellow River Delta

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1. Introduction

The interactions among river water, groundwater, and sea water have been considered to be one of the important processes to evaluate the water and nutrient budgets from land to sea (e.g., Taniguchi et al., 2002; Burnett et al., 2003). To better understand the interaction among the Yellow River water, groundwater, and sea water at the Yellow River Delta area, it is necessary to quantify the regional groundwater table in the region. In this preliminary study, we conducted the static GPS survey and water table measurements to delineate the regional groundwater table.

2. Static GPS survey and comparison with DEM data

We first conducted the static GPS survey for more than twenty-five points to obtain the elevation data in the studied area (**Figs. 1 & 2**). Then, the obtained data were compared with three-arc-seconds (about 90 m) DEM data

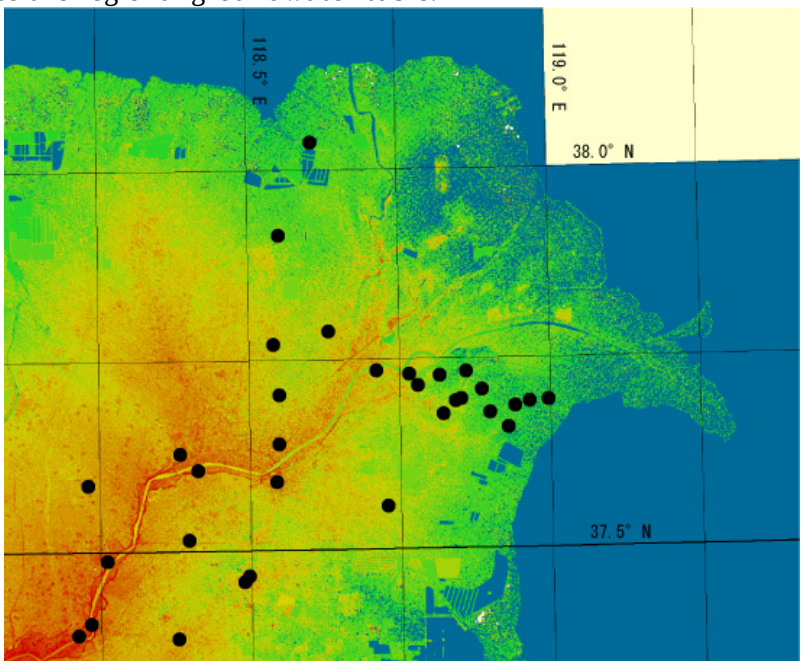

Fig.1 Topographic map of the Yellow River delta constructed using 3-arc-seconds DEM data obtained by SRTM. Dots indicate the locations where the static GPS survey was conducted.

Fig. 2 Static GPS survey.

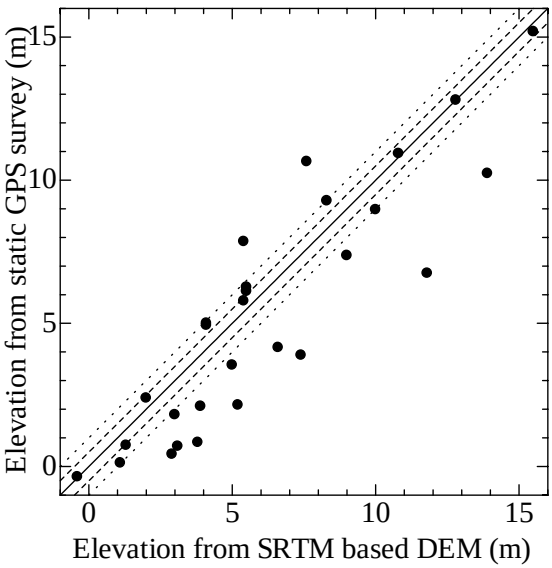

Fig. 3 Comparison between DEM elevations and GPS elevations. Line shows 1 to 1 correlation, dashed line deviations of ±0.5 m, and dotted line that of ±1 m, respectively.

(**Fig. 1**) produced by SRTM (Shuttle Radar Topography Mission), which is the best available DEM data in the studied area. The DEM data tend to show higher elevation (more than three meters difference at several locations) compared with the GPS data (**Fig. 3**), suggesting that the three-arc-seconds DEM data are not detailed enough to use as the base map for the groundwater survey and that the static GPS survey (accuracy of the elevation measurements is about 75 mm in this case) is indispensable for obtaining precise regional groundwater table.

3. Characteristics of regional water table in the Yellow River delta

Obtained data show the decrease of water table elevation from the Yellow River to the coast, indicating that the Yellow River water is recharging at least to the shallow groundwater (**Figs. 4 & 5**). The comparison between regional groundwater table at September 2003 and that at May 2004 showed the water table drop from September to May (**Fig. 6**). Our results also suggested that the groundwater potential of the shallower wells was higher than that of the deeper (20 m) wells (**Fig. 7**). The electric conductivity values of shallower wells are significantly lower than those of deeper wells (**Fig. 8**). Previous geological study (Xue et al., 1995) showed that upper 4 to 5 m of the sediments in the studied area is composed of upper delta plain facies. On the other hand, the

underlying sediments were deposited mainly sub-aqueous delta and lower delta plain environments (**Fig. 9**). The observed differences of groundwater potential and electric

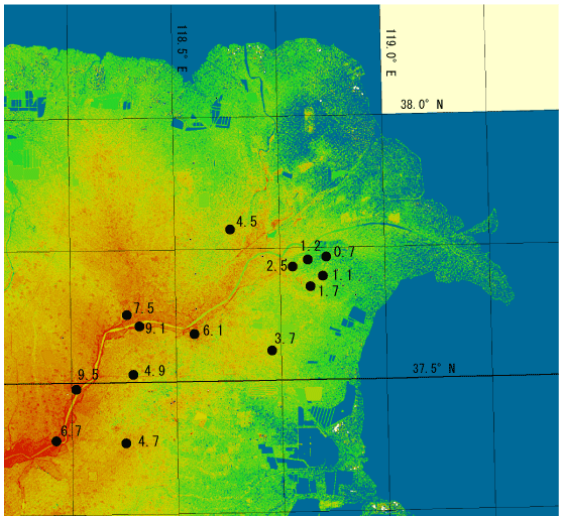

Fig. 4 Water table elevations (in m) of the shallow aquifer at September, 2003.

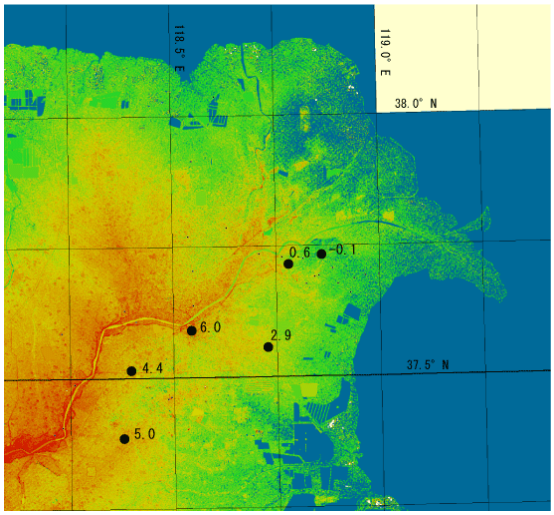

Fig.5 Water table elevations (in m) of the shallow aquifer at May, 2004.

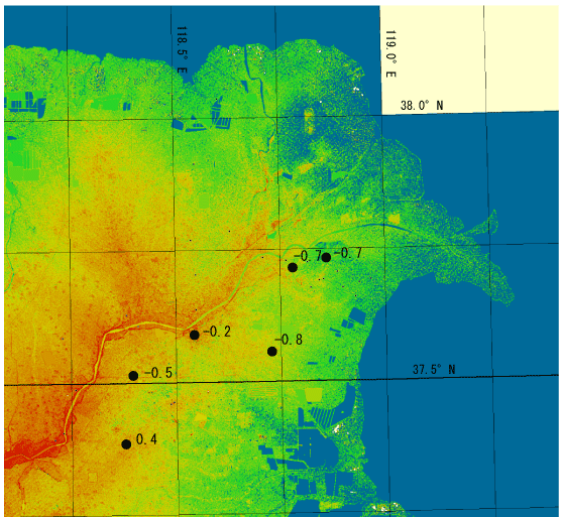

Fig. 6 Change of water table (in m) between September, 2003 and May, 2004. Negative sign indicates the water table decline from September to May.

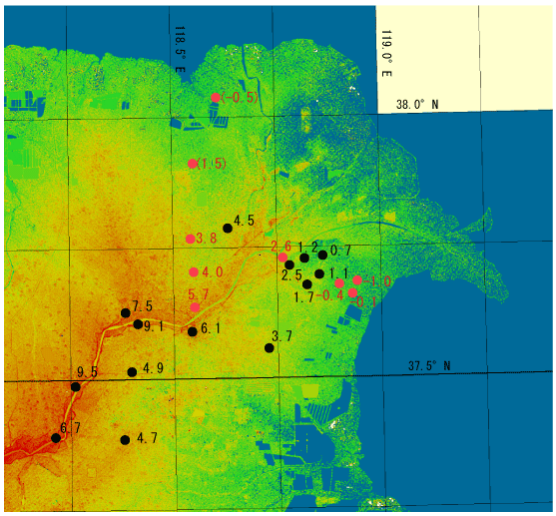

Fig. 7 Water table elevations (in m) of the shallower wells (black dots and number in black) and those of deeper (20 m depth) wells (red dots and number in red). Note that groundwater potential of shallower wells are higher than that of deeper wells.

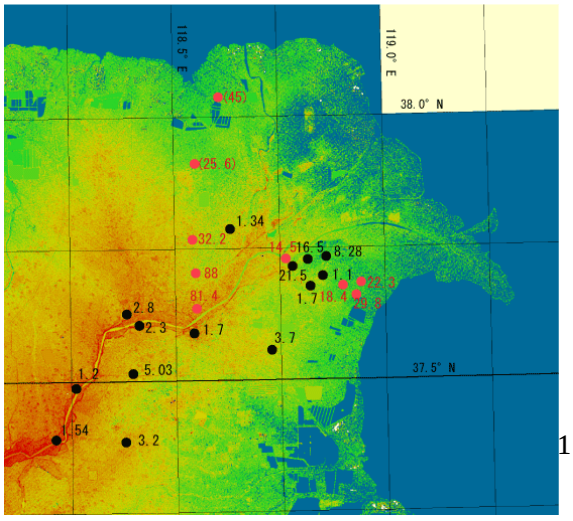

Fig. 8 Electric conductivity data (September, 2003) of the shallower wells (black) and the deeper wells (red).

conductivity values together with the geological information suggest that the different hydrogeological systems exist in the Yellow River delta area.

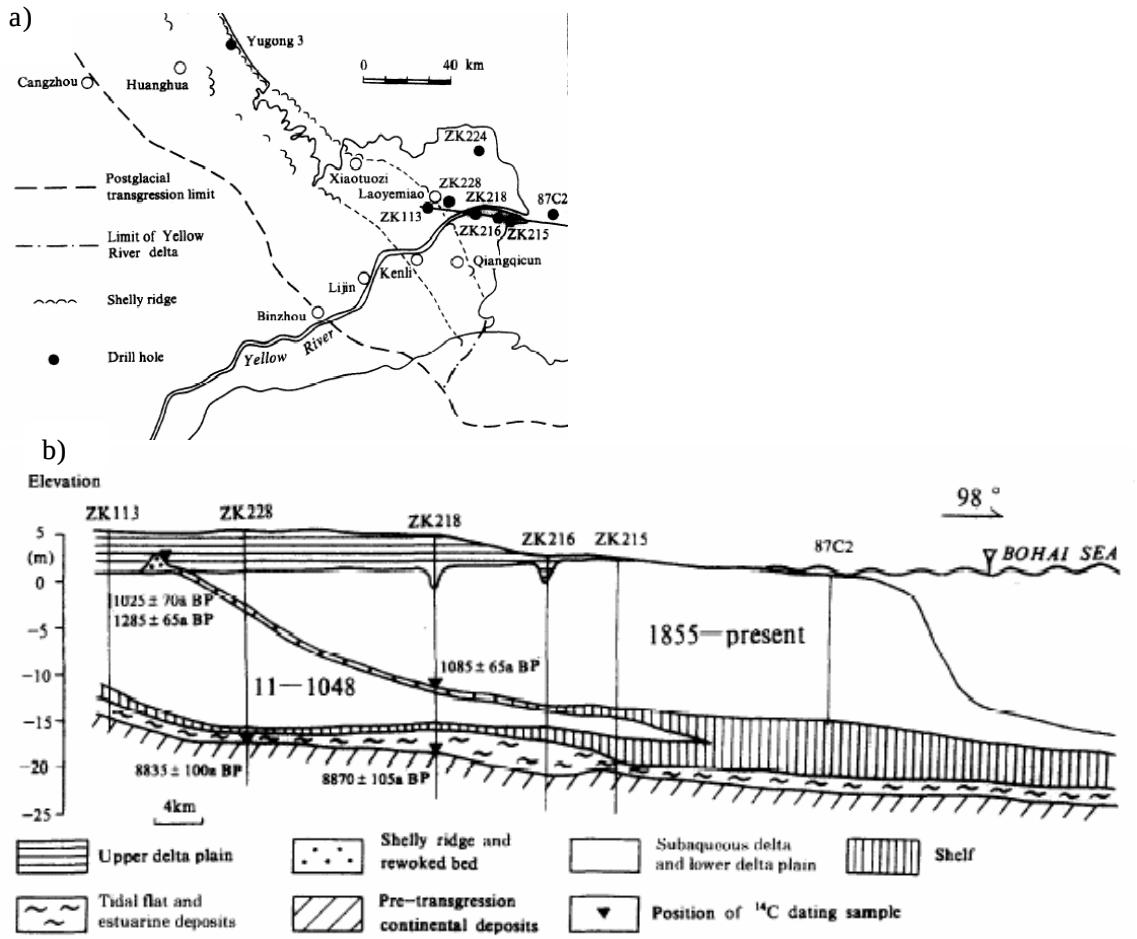

Fig. 9 Cross-section through the modern Yellow River delta showing the Holocene sedimentary sequence (b). See (a) for location of the section. After Xue et al. (1995).

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